SNOW COVER DYNAMICS IN THE EUROPEAN ALPS DERIVED FROM MEDIUM RESOLUTION EARTH OBSERVATION IMAGERY

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Introduction

Snow cover dynamics in the alpine region are of great importance for the regional climate, fresh water, hydropower generation, biodiversity, natural disasters, and tourism. The European Alps are a fragile ecosystem, in which snow cover is particularly sensitive to climate change. Thus, monitoring snow dynamics within the Alpine area may not only assist to determine local vulnerability, but also provide a regional assessment of the ongoing climate change.

Datasets and processing

Within this study we have analyzed the daily snow cover information provided by DLR's (German Aerospace Center) Global SnowPack (GSP) product to identify snow cover developments in European Alps between 2000 and 2016. The Global SnowPack is a medium resolution (500 m) reprocessed time series based on the Moderate Resolution Imaging Spectroradiometer (MODIS) snow cover products, and all gaps caused by cloud cover or polar darkness have been interpolated to provide a gapless time series of daily data.

To characterize the snow dynamics in different elevations, we divided the whole Alps into several elevation zones starting from 600 m to the maximum with a 150 m step. For each elevation zone, we have developed two parameters: Snow Cover Persistence (SCP) and Altitudinal Snow Cover Fraction (ASCF) which can be calculated according to Eq. 1 and Eq. 2.

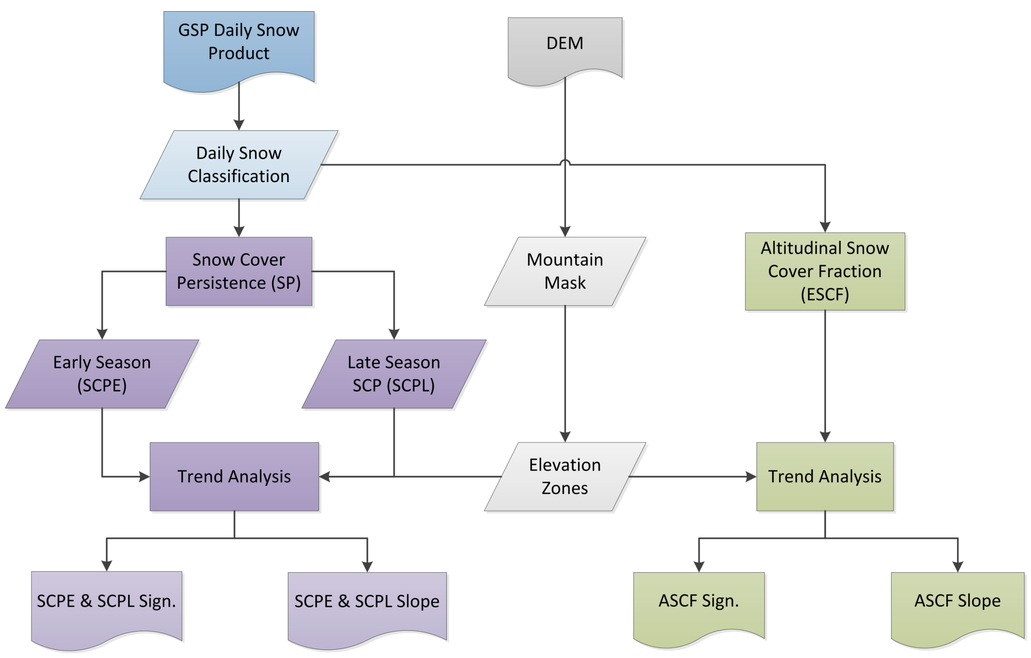

Fig. 1: Calculation of the Snow Cover Persistence and Altitudinal Snow Cover Fraction

$$SCP_{ij} = \frac{SCD_{ij}}{t} \qquad \text{Eq. 1}$$

in which the SCP of pixel i within the elevation zone j (SCP_{ij}) is represented by the ratio between the total number of Snow Cover Days (SCD) and the length of studied period t.

$$ASCF_j = \frac{SP_j}{P_j} \qquad \text{Eq. 2}$$

In which the ASCF within the elevation zone j ($ASCF_j$) is the ratio of the number of snow covered pixels (SP_j) divided by the total pixel number of the elevation zone j, P_j.

To capture both the variation of the total snow persistence and the shift in accumulation and ablation period, SCP is calculated separately for the early season (01. September to 15. January) and the late season (16. January to 31. August).

Results and Outlook

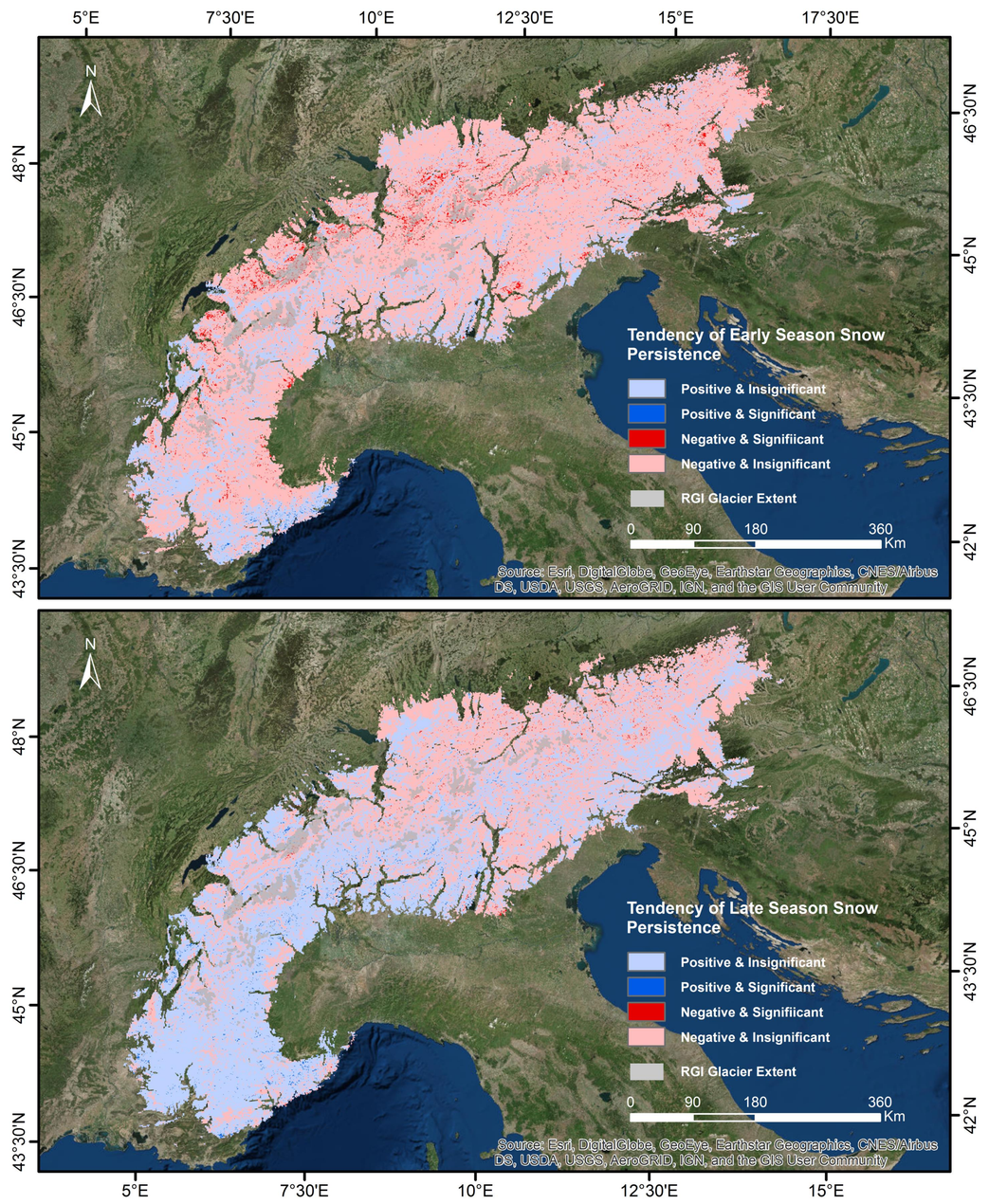

Fig. 2: Tendency of Snow Cover Persistency between 2000 and 2016

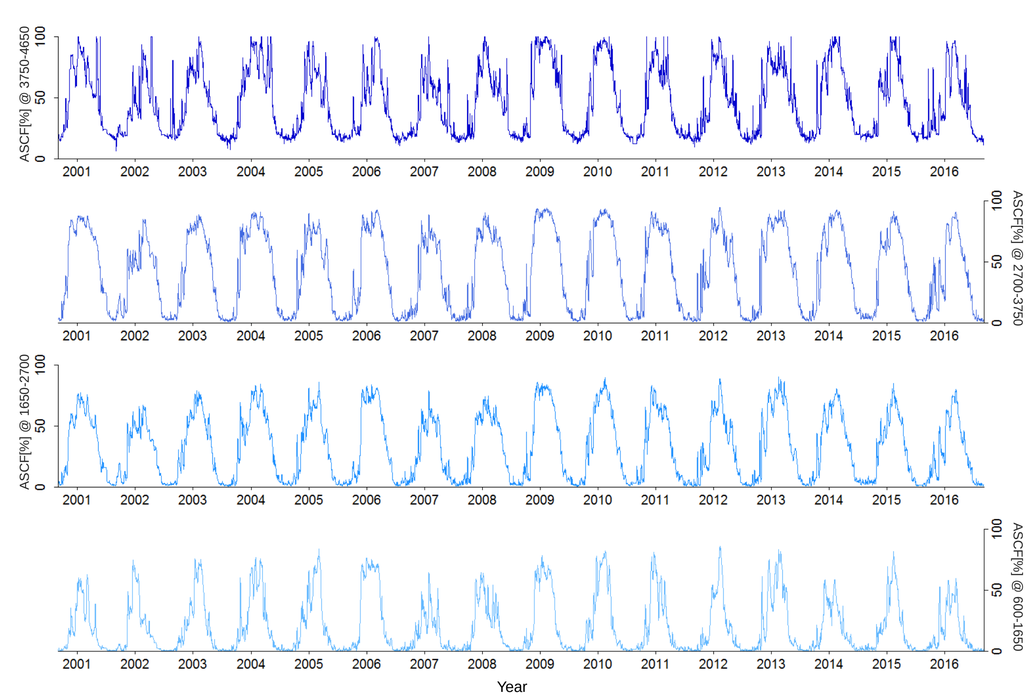

Fig. 3: Altitudinal Snow Cover Fraction between 2000 and 2016

- In the Northern Alps, SCP tends to be shorter, especially during the early season.
- The most significant reduction of snow cover persistence is observed in the Northern Alps, particularly in the glaciated areas documented in the Randolph Glacier Inventory (RGI).
- In the highest elevation, the baseline of ASCF is greater than 0, which indicates the existence of multi-year persisted snow and ice. However, the limited number of the observation prohibits a statistical analysis for such parameter.

The next step of this study would be to look into the long-term time-series derived from high-resolution imagery (e.g. Landsat) to perform more statistically trustable trend analysis.

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